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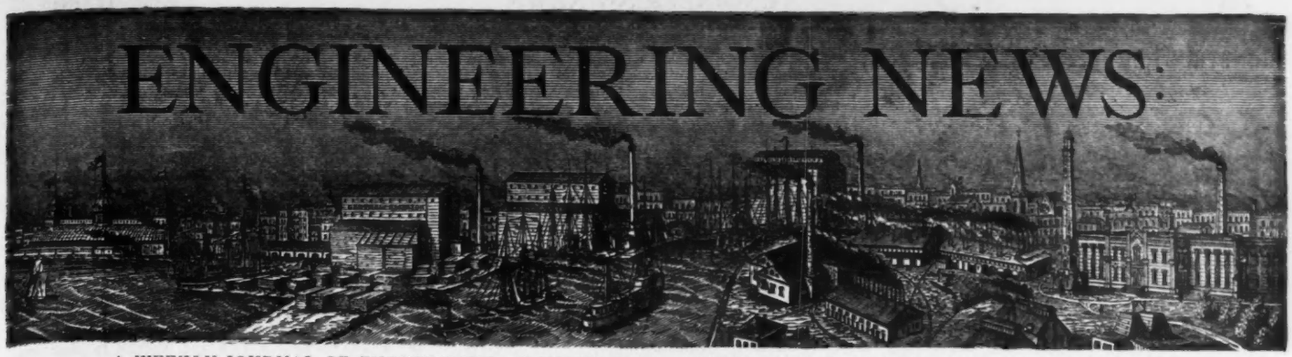
# ENGINEERING NEWS.



A WEEKLY JOURNAL OF ENGINEERING, ARCHITECTURE, MINING, MANUFACTURES, AND GENERAL SCIENCE.

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## Partial Report of the Committee on the Metric System.

CHICAGO, April 4th, 1876.

*To the President and Members of the Civil Engineers' Club of the Northwest.*

GENTLEMEN:—Your Committee to whom was referred the circular of the Boston Society of Civil Engineers, asking the co-operation of our Club in petitioning Congress to fix a date, after which the metric weights and measures shall be the only legal standard, beg leave to report as follows:

Some of the Committee have been for some time familiar with the metric system, and with the main arguments, for and against its introduction. Others, with less previous knowledge, have sought information from President Barnard's address before the Convention of the University of the State of New York, advocating the system, and the paper of Mr. Coleman Sellers, read at the Convention of American Railway Master Mechanics in this city, May 1874, adverse to the system.

President Barnard gives with great force the argument based upon the permanance of the unit of length, the derivative quality of the measures of capacity and weight and the simplicity of their relations to each other, the great saving of labor and of chances of error in computation, and the facilitating of scientific and commercial relations with the numerous Nations and States that have already adopted the system.

Mr. Sellers, in his very able paper, makes little, if any, objection to the system itself, and admits that it could be easily learned, but grounds his objection to its introduction mainly or wholly upon the cost of changing the drawings, patterns, tools, machinery, gearing, &c., from signs that are simply expressed in inches and fractions to signs that are simply expressed in millimeters. For a machine shop employing 250 men, Mr. Sellers estimates the cost of necessary alteration of tools at $27,000 and of drawings and patterns at $150,000.

He suggests that the American idea, originated by Eli Whitney, of making homologous parts of fire arms so precisely alike as to fit any arms of the same pattern, has spread to the manufacture of sewing machines, clocks watches, and many other articles, and so has compelled the adoption, by all makers, of uniform scales of screw cutting, gearing &c. all expressed in inches, all of which must be remodeled to find simple expression in the new quantities. And there are many other costly changes to be made which will occur to any one at all familiar with mechanical operations.

The advocates of this new system seem not to have been blind to these difficulties, but urge that they would be offset by the advantages named above, and this opinion your Committee share.

We have prepared, and present herewith a memorial to Congress upon the subject, and if this be adopted by the Club, we suggest that the Club through its officers invite the co-operation of scientific and learned bodies in this vicinity, such as the Chicago Academy of Science, the Chicago Chapter of the American Institute of Architects the Athenaeum and Mechanics' Institute, the Universities, the Chicago Master Masons and Builders' Association, the State Microscopical Society, and others. And the Board of Education might properly be asked to require the study of the system by tables and models in the higher classes of grammar schools.

We believe that a full discussion of the subject by the Club would be of benefit, and we suggest that an early meeting of the Club be set apart for that purpose where the metric system might be presented in its bearing on the labors of the Engineer, the Architect, the Mechanic, the Land Surveyor, the Physicist.

We have procured, and placed at the service of the Club a copy of President Barnard's address and of Putnam's pamphlet on the metric system.

We present this as a partial report and ask leave to sit again. Respectfully submitted,

SAMUEL S. GREELEY, Chairman.

*To the Honorable: The Senate and the House of Representatives of the United States, in Congress Assembled.*

Your memorialist "The Civil Engineers' Club of the Northwest" would respectfully represent:—

That all who are engaged in Civil Engineering in the United States are subjected to extra labor, grevious loss of time, and intolerable inconvenience by the use of the complex and incongruous system of weights and measur- which is established by law.

The different denominations of this system do not vary in a decimal ratio; but its multiples and subdivisions, established by accident or caprice, are difficult to remember, and extremely inconvenient in use, and the computations involved are so tedious that not only the labor required to perform; but the liability to error is largely increased. And these computations make a large part of the labors of the Civil Engineer.

By adhering to a system so odd and peculiar, we deprive ourselves of a large share of the advantages which flow from a ready interchange of ideas with the people of other nations which have adopted the metric system, and this loss is especially felt by the Civil Engineers of our Country.

The metric system has become international through its almost universal adoption by civilized nations. Its base is unalterable. Its units have the same relative values as those of our system of numbers, so that all computations may be made in decimals. Its units of length, surface, volume and weight are mutually related and its nomenclature is simple and expressive of value.

If adopted in the United States it will greatly facilitate the transaction of the entire business of the country and it will aid commerce by removing the liability to delays, inaccuracies and difficulties in reducing values from one system to another and it will diminish the chances of imposition which results from a diversity of system.

Your memorialists therefore earnestly pray that you will enact that after some date, to be fixed several years in advance, the metric standards in the office of weights and measures at Washington shall be the sole authorized public standards of weights and measures in the United States. And your memorialists as in duty bound will ever pray.

## Drainage of New Orleans.

The levee is a necessity, as the city is several feet lower than the Mississippi River. After a heavy rise many of the streets are flooded, but the gutters are so graded that the water passes rapidly into artificial canals intersecting the city, the contents of which are lifted by draining machines into the level of Lake Ponchartrian through the agency of tail-races several miles in length, connecting the machine with the lake. A more comprehensive plan, has, however, been devised by Major Hardee the corporation engineer, which, when completed, will not only provide for a more thorough drainage, but will admit of a system of underground sewerage. It consists of two large levees at the upper and lower part of the city extending from the Mississippi River across the city to Lake Ponchartrain. These levees are about 20 feet high, and sixty feet wide, and are formed from an excavation which constitutes a drainage canal. They are connected on the lake shore with a corresponding levee and canal. The drainage machine will be removed to the lake terminus, and the canals will there be emptied.

## Notes.

A narrow gauge railroad is strongly advocated, to be built from Wiscasset, Maine to Quebec.

The City Council of Fort Wayne, Indiana, has confirmed the appointment of Moses Lane to superintend the building of the water works. This will insure the adoption of the stand-pipe system.

A portion of the trestle-work of the Delaware, Lackawanna and western railway, at the Passaic river crossing, which is several hundred feet high, fell on Monday, 3d inst. while a number of men were employed in strengthening it. Two men were killed, and three others injured, probably fatally.

It may not be uninteresting to know what it costs to run the Rockford Holly Water Works, especially when one remembers the difficulties and opposition encountered in putting them in. The following shows: From Aug. 1, 1875, to April 1, 1876, 81,044,467 gallons pumped; cost of coal, $969.94, or $1.19 per 1,000 gallons. It is comforting to know that Rockford pumps water 50 per cent. cheaper than any other city. In New Bedford it costs $2.70 per 1,000 gallons, and in every town, so far as your correspondent is informed, it costs more than in Rockford. Economy is wealth.—*Rockford Correspondence Chicago Tribune.*

The rainfall of the last of March was enormous, amounting, in some places, to more than half the total rainfall of ordinary years. Disasters were frequent. Many dams yielded from increased pressure, and more from the shock of flood waters let down by the failure of reservoirs up stream. At Clinton, Mass., four large ponds of the Ware Mills broke away, March 26. At Burrillville, R. I., five dams, from Wilson's Reservoir to Oakland, gave way. On the Connecticut river, the East Haddam Buckle Co's dam failed. Two dams near Middleton, one at Rocky Hill, one at Durham Centre, one at Salmon river one each at Stourbridge, Danielsonville, Norwich and Lisbon were carried away. Some of these were small and slightly built, and some old and decayed.

## The Toledo, O., Water Works

The stand pipe system is used. The stand pipe is made of a No. 1 charcoal iron one-half inch plate five ft. in diameter, and inclosed by an octagonal brick tower neatly capped with stone and resting upon a solid granite foundation.

A filtering bed and settling basin are used with a filtering capacity of 1,000,000 gallons per day. The water first enters the settling basin where it remains about twenty-four hours, and then passes by means of an overflow well into the filtering bed made of gravel with a sufficient number of gathering drains, the whole bed covered with sand to the depth of two and a half feet. After the filtration the water passes into the pumps. The water of the Maumee river at Toledo is very impure, and for domestic supply filtration is indispensable. After the water passes through the filtering bed there remains upon the surface all the substance in suspension which the water originally contained. These particles form a glutinous carpet to the depth of a quarter of an inch, and can readily be rolled up like a carpet and removed.

The two engines furnishing the power are of the style known as the Worthington Duplex Compound, and since being placed in position have cost nothing for repairs. With one engine running, and 140 feet head in standpipe, the supply of water given is 2,250,000 gallons in twenty-four hours, 60 pounds water pressure, 20 strokes to the minute, 160 gallons per stroke each; duty, 55,000,000 pounds per 100 pounds of coal coal consumed.—*Ft. Wayne Sentinel*

# CONSTRUCTION OF A MASONRY DAM.

BY J. JAMES R. CROES. C. E.

From the Transactions of the American Society of Civil Engineers, New York.

CONTINUED.

## PROGRESS OF CONSTRUCTION.

Work was begun in September, 1866. A new channel was made for the stream near the base of the North-east Hill, an embankment built around the remainder of the dam site, on the flat ground, and carried up 10 feet above the stream level. The pit within this embankment was partially excavated, the material being deposited below the dam. The quarrying and cutting of stone was begun, and a Blake's stone-breaker put in operation. On October 29–30, 3.91 inches of rain fell in 10 hours, causing a heavy freshet which washed away the contractor's bridges, filled the pits with water, and cut embankments badly. After pumping out the pit, the excavation was continued until December 21st, when the pit was allowed to fill.

Some observations of work done in bailing from a pool into a trough 4 feet above the water, showed that the average work per minute, of a man was 12 bucketfuls, equivalent to about 1,200 pounds of water 1 foot high.

The winter was devoted to quarrying and breaking stone. Some cement was delivered, but was found not to be equal to the requirements of the specifications. A cargo of 900 barrels was rejected, and the delays and discussions consequent upon this prevented the receipt of any more cement until spring.

The great distance of the work from any rail or water transportation was a serious drawback. The nearest point to which supplies could be brought by water was 16 miles distant, and over a very bad road. The nearest railroad station was 8½ miles distant, on the Harlem Railroad.

Sand, of proper quality, was difficult to get. All the bank sand within many miles was tested and rejected as containing too much dust and loam. The only sand found at all admissible was procured from the bed of the stream, in pools where the flow was sluggish and the sand had settled. Most of this was of good quality, but some was very dirty and had to be washed, and all of it had to be screened to remove chips and coarse material. From beginning to end of the construction of the dam there was a continuous struggle on the part of the engineer to have the sand for mortar properly cleaned and screened, and of the contractor to avoid it. That sand should be sharp, clean, and screened to proper size, is absolutely essential to good mortar, and there is no point on which, as a general thing, contractors and builders are so lax. Several methods of washing were tried, of which the most successful consisted in spreading the sand in a layer of about 3 inches in depth on the bottom of a shallow box, 6 feet by 12 feet, slightly inclined, and playing upon it with a hose from a force-pump. With proper manipulation the sand was pretty thoroughly cleaned. The process was expensive, however, and after one or two loads were operated on in this way, the sand would come to the work much cleaner.

In the spring of 1856 the main pit was pumped out, and excavation continued. The engine and boiler of 15 horse-power used for running the stone-breaker, were placed on the embankment above the pit, so as to operate a hoisting drum and an Andrew's pump throwing an 8-inch stream. After the pit had been once emptied, the pumping did not need to be continuous. The engine was able to hoist material from the pit, and at the same time either pump or break stone, but not together.

North of the stream the foundation for the gate-house was prepared. On the side towards the stream, a trench 3 feet wide and 4 feet deep, was dug to the rock and filled with concrete, as a temporary dam to keep water from the gate-house pit. This concrete was made with 24 feet of broken stone to 1 barrel of cement and 2 of sand, and was deposited gently in the still water which filled the trench. It was not rammed, but the wet mass was worked down with shovels. One year afterwards, when this concrete was removed to make the connection with the gate-house, it was found necessary to drill and blast it. It had formed a good bond with the rock, and apparently no water had passed under it.

The first stone of the dam was laid July 9th, 1867, in the gate-house foundation, and concreting was begun in the main pit, July 11th. During the rest of the season the foundation in the main pit was raised to the stream level, and the masonry of the gate-house and waterways was carried up 8 feet. The side of this, towards the stream, was built vertically, the concrete being put in against plank forms. On the removal of this during the following year, the face of the concrete was found good. To connect the new work with it, and avoid a straight joint through the dam, two vertical channels were cut in the concrete, 3 feet wide and a foot deep. These were cut by a stone-cutter, with a point. A pick made no impression on the concrete.

Masonry was suspended November 5th, and the concrete already laid, covered with 2 feet of earth to protect it from the frost. Some rubble masonry was laid after that date in wing walls adjoining the waterways above and below the dam. In freezing weather the mortar was mixed with salt water. The rule for proportion of salt was one said to have been used in the works at Woolwich Arsenal some years ago, viz.: dissolve 1 pound of rock salt in 18 gallons of water when the temperature is 32° Fahr., and add 3 ounces of salt for every 3° lower temperature. The masonry laid with mortar thus prepared stood well, and showed no signs of having been affected by the frost. No masonry in the dam was laid in freezing weather.

The ensuing winter was very cold and stormy. Quarrying, cutting and breaking stone were carried forward, and sand and cement hauled. The water of the stream was carried through the gate-house.

Work on masonry was resumed March 30th, 1868. The first part of the season was wet. A very heavy freshet occurred May 14th. The water rose 3 feet on the masonry laid in gate-house, and filled the pits. The latter part of the season was very dry, however, and the whole dam was raised 16 feet above the stream. Work was closed November 17th, and the masonry covered as before with 2 feet of earth.

During the latter part of this year's work it had become evident that the insertion of large stone in the concrete was not beneficial. The space between the side walls was becoming narrow; at the close of work it was 21 feet. The dam was 400 feet long and 6 feet above the earth filling. It was no longer practicable to wheel the concrete from the mixing boards in barrows, but it had to be hoisted by derricks and transported by cars. When a course of facing-stone had been laid, and the space between them was to be filled with concrete, and that filled with irregular shaped stones 1½ or 2 feet apart, it was difficult to get an even bearing for run plank and almost impracticable for a tramway. The odds were greatly against the concrete around these stones being properly distributed and rammed, if it was dumped from a car. Even when distributed by the barrow-full (2 cubic feet), it required constant attention and no small amount of persistence to secure its being spread in the narrow spaces. The stone in the vicinity of the dam which was fit for cutting had been pretty thoroughly used up, and it was questionable whether a sufficient quantity to finish the dam could be procured at all, if 3,000 additional cubic yards were put in the hearting. The scarcity of good stone caused a constantly increasing tendency on the part of the contractor to run in and cover up weather beaten stones which were unfit for the work on account of the impossibility of the mortar adhering properly to the weather face. It had several times occurred that such stones were brought in, and a little grout poured over them to hide the deficiencies, and very probably more of the same kind were never discovered. It is questionable, moreover, whether so great solidity and tightness could be obtained by a wall of large stones, surrounded by thin masses of concrete, as by a thick mass of concrete alone. After full discussion of the subject, it was determined to abandon for the rest of the dam the use of the large stone, and use only concrete for the hearting. These objections to a wall of concrete and large rough stones apply mainly to thin walls, say of less than 10 feet in thickness, intended to resist water. A wall of this class may be laid to advantage when over 10 feet thick, but the stone should be required to be regular in shape, of not more than 18 inches height, and no stones should be allowed to be less than 2 feet apart. By their use under these restrictions, the specific gravity of the wall may be increased and its cost diminished, and with a much greater certainty of getting good work and tight, than if the wall is laid up with rubble masonry.

The laying of masonry was resumed June 23, 1869, and continued until November 1st, when the wall had reached an elevation of 38 feet above the stream. The masonry was again covered with earth 2 feet thick, which was found to protect the concrete from frost quite well. In some places it was necessary to remove from 2 to 3 inches of the old work in the spring. The winter was devoted as usual to quarrying. cutting and breaking stone. Enough broken stone was prepared to finish the dam.

Work on masonry was resumed, April 13th, 1870, and the dam, as originally designed, was completed by November 1st, 1870. Owing to the changes of plan mentioned above, the reservoir was not ready for use until the fall of 1872. The dam contains, approximately, 21,000 cubic yards of concrete, and 6,000 cubic yards of cut stone masonry.

## GENERAL METHOD OF HANDLING MATERIAL.

No expensive plant or machinery was used. The builders were a contractor's office and cement house on the flat below the dam, stables and blacksmith shop near by, and a shed for stone-cutters on the flat above the dam. The stone yard was just above the dam on the north-east side of the stream. The stone for cutting and breaking for the first two years was procured from the hill-side, within 1,000 feet of the yard, and from 50 to 300 feet above it. The third year the haul was about 2,000 feet, and the last year most of the stone for cutting was hauled 2 miles. From the neighboring hills, the stones were transported on stone boats, with oxen. For long hauls, low trucks were used, the stone being first brought to the road on stone boats. When the hill-sides were dry and rocky, the wear of stone boats was enormous. For transporting the cut stone from the yard to the work, trucks drawn by horses were generally used, depositing the stone within reach of a derrick on the work. In the main pit a double-geared derrick, with 50 feet boom, was at first used for setting stone. Its great weight made it unwieldy, and for the last two seasons derricks of 30 feet mast and 25 feet boom were used. These could readily be shifted and raised. A heavy block, with a socket for the pin at the foot of the derrick was laid on the concrete, and boards around it for the hoisters to stand upon. The derricks were worked by hand until the masonry was 10 feet above the bank. After that 2 steam hoists were used, a vertical 8 H. P. engine, with drum, being placed on the lower side of the dam, and the fall brought to it over the edge of the masonry. All the material to be hoisted was delivered under the boom on the vertical side of the dam.

Below the embankment level, the sand and cement for mortar were mixed dry on the bank, and sent into the pit by a shute, to the mixing board. The broken stone was sent down another shute and measured below. From the mixing board it was transported to place in barrows. When the masonry had reached a height of 6 feet above the bank, the mixing platforms were placed on the bank close to the vertical wall, the concrete shoveled from the board into boxes, which were hoisted, placed on a dumping car, running on a track of scantling resting on notched ties laid on the concrete, and wheeled to place and dumped. The track was carried along on top of the new work. As the concrete was dumped from the car, it was leveled off to about 8 inches thick and rammed. From two to three layers, according to thickness of the course of the face walls, were put one over the other. With the track in the centre of the wall, a width of 20 feet could easily be carried forward, the car being arranged to dump in any direction. The plan worked pretty well, but was a little expensive for the contractor, as the ties became more or less imbedded in the soft concrete, and consequently there was more loose stuff to be removed in preparing for another course than if no traveling over the fresh work had occurred. Boards laid along the track, for the car-tenders to walk upon, protected the green concrete.

Stone for masonry was hoisted in the same way, and carried to the setting derricks, which were worked by hand, the reach of the boom being regulated by the topping lift, and, of course being altered for every stone that was set. The courses were laid from one end of the dam to the other, so that, while one hoister was raising stone, the other was raising concrete for filling the space between the stones already laid at the other end of the dam.

The stone breaker was at first placed on the bank above the dam, and the broken stone passed from it to the meadow at the stream level. This arrangement was necessary so as to utilize the engine for pumping, but had the disadvantage of causing the stone to be hauled up again from the meadow. After pumping was no longer necessary, the breaker was placed on the hillside in such a position that it was fed from the quarry direct, and delivered stone a little above the level where it was needed, making all the haul descending.

Wire guys were used on the derricks, and for a part of the time, when the steam hoist was used, the falls were of annealed wire rope. This generally worked well, but had one disadvantage; it would sometimes break suddenly, without warning, and it took longer to repair than rope.

All arrangements for transportion and hoisting were under the contractor's direction, the engineer only seeing that nothing should be done in a manner detrimental to the work.

## CHARACTER AND COST OF MATERIAL

I. *Cement.* The specifications required that all cement should be of the best quality of American hydraulic, and subject to such tests as the engineer might direct. For this work it was not so essential that the cement should be quick setting, as that it should be strong. For concrete, a quick setting cement is not to be preferred.

The first cement, delivered in October, 1866, contained a considerable amount of coal dust, was apparently not thoroughly calcined, and, when sifted, 22½ per cent. by weight would not pass through a sieve with openings of one fortieth inch. The catgo was rejected. The contractors claimed thst they could not procure any better cement. All of the Rosendale works were visited, and only one company would agree to furnish a cement which should contain less than 15 per cent. of matter coarser than one fortieth inch. The other companies said they had a ready sale for any cement they offered, and would not go to additional expense and trouble to grind the cement finer. The company which consented to make an effort to improve their cement furnished nearly all that was used on the dam, and, out of a great many samples tested for fineness, only three were found to equal the limit assigned. In 1869–70, samples of several different cements for sale in the New York market were tested with the results shown in the following table. Different brands are designated by different letters. "B" was the cement used on the dam.

Tests of the tensile strength were made. The blocks had a sectional area of 2¼ square inches, with shoulders for clamps. They were mixed in moulds, immersed in water for twenty-four hours, and broken after having stood for from seven days to a year and a half. No practical use was made of these tests at that time. The results of a large number are given in the table:

An analysis of the whole series of experiments appeared to establish these facts:

(a.) The average tensile strength per square inch at the end of seven days, of cements, of which less than 10 per cent. by weight was over one fortieth inch in diameter was 54½ pounds, while that of those of which more than 15 per cent. was over one fortieth inch diameter, was 39 pounds.

(b.) When cements containing from 10 to 23 per cent. of particles over one fortieth inch diameter were

sifted through a "40" sieve, the tensile strength of the fine portion was 20 per cent. greater than that of the cement before sifting; but in cements containing from 23 to 30 per cent. of the coarser particles, the removal of those particles reduced the tensile strength of the cement about 25 per cent.

| | Fineness. Percentage by Weight. | | | | | | Tensile Strength. Lbs. per sq. inch. | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Brand. | Over 40 | 40 to 80 | | Brand. | Over 40 | 40 to 80 | Brand. | 7 days | 21 days | 3 mo. |
| 1867 | A | 22.5 | 7.5 | | C | 19.4 | 11.2 | A | 32 | 94 | 111 |
| | A | 16.0 | 11.0 | | C | 26.3 | | B | 49 | 111 | |
| | B | 15.0 | 11.0 | | D | 15.9 | 11.1 | B | 61 | | 135 |
| | B | 14.0 | 11.0 | | E | 15.4 | 10.9 | B | 61 | 84 | 100 |
| 1868 | B | 7.4 | 11.1 | | F | | | B | 58 | 101 | |
| | B | 10.0 | 13.7 | | G | 22.8 | | B | 56 | 63 | |
| | B | 12.5 | 13.7 | | H | | | B | 50 | 66 | |
| | B | 6.6 | 8.4 | | I | 28.8 | | C | 37 | 66 | 75 |
| | B | 4.. | 6.0 | | J | 7.5 | | D | 48 | 82 | 82 |
| | B | 20.0 | 5.0 | | K | 20.0 | | E | 59 | 62 | 73 |
| 1868 | B | 6.6 | 4.1 | | L | 18.8 | | F | 55 | 62 | |
| | B | 9.4 | | | | | | G | 66 | 94 | 99 |
| | B | 15.0 | 6.0 | | | | | H | 28 | 65 | 95 |
| | B | 10.0 | 5.3 | | | | | I | 26 | 59 | 72 |
| 1869 | B | 8.0 | 4.7 | | | | | J | 54 | 80 | 87 |
| | B | 6.2 | 4.7 | | | | | K | 35 | 69 | 77 |
| | B | 8.1 | 5.6 | | | | | L | 26 | 74 | 84 |

(c.) The tensile strength of the cements increasd continuously for 6 months. Reliable observations for longer periods were not obtained. The maximum results were:

| Time | 7 days. | 14 days. | 21 days. | 3 mo. | 6 mo. | 9 mo. |
|---|---|---|---|---|---|---|
| Pounds per sq. in... | 86.5 | 89 | 111 | 155 | 222 | 250 |

(d.) The cements which gave the best results at seven days generally maintained their superiority throughout.

Some of the cements used which set quite slowly at first, made exceedingly hard concrete. The most compact concrete which was cut into at any time was made with a lot of cement which barely escaped condemnation on account of its setting so slowly. No samples of the brand used refused to set under water.

A systematic testing of *all* the cement used on a work situated as this was, is very difficult. From 2,000 to 3,000 barrels were used in a month. and it sometimes happened that, owing to delays in transportation, all the cement used for seveal days in succession was delivered directly at the concrete boards by the teams which hauled it from the railroad. It is due to the cement company which furnished the cement to say that it was generally very satisfactory. The difficulty with most of the cement companies now is, that during the summer their works are taxed to their utmost capacity to supply the market, and, in ordinary building, almost anything that bears the Rosendale brand is accepted without question, so that there is no inducement for them to take any pains to improve the quality of their cement. The experience of Mr. Shedd on the Providence (R. I.) sewers shows, however, that it is not only practical to make tests of all cement used on a large work, but to raise the standard of that which is furnished.

The average weight of a barrel of cement used on the dam was 284 pounds net.

II. *Broken Stone for Concrete.*—Stone for concrete was broken to be not more than 2 inches in its largest dimension. A Blake's stone-breaker of 16-inch jaw was used, driven by a 15 horse-power engine. The stone which was obtained from the surface and from old fence walls in the vicinity of the work was tough and used up the jaws very fast. A movable jaw ordinarily lasted 20 days. On one occasion, a jaw costing $70, and which had been hauled 16 miles over night and but in the machine in the morning, was so worn by night as to be useless. With chilled jaws and careful handling, and using quarried stone instead of stone from the surface, a pair of jaws lasted much longer on the latter part of the work. The last pair used proke about 3'000 cubic yards of stone.

As the stone passed from the breaker it traversed an inclined screen, made of ½-inch iron rods placed parallel, about ¼-inch apart, on a slope of 1 to 1. The dust and screenings were carted away, and the stone wheeled into a pile. One, and sometimes two men were necessary on the dump, to break the larger stone as they were deposited. With a fresh set of jaws no additional breakage was needed, but as they became worn, stone in excess of the proper size would sometimes pass. The stone was delivered to the breaker by carts, having been first sledged to the proper size, about, 12 inches square, by 6 inches thick. The machine when running at full speed, with one man feeding, two men supplying him with stone, one keeping the screen clear and helping to fill barrows, two wheeling away the stone and one on the dump, could break 144 cubic feet in an hour or at the rate of 54.4 cubic yards per day of 10 hours. This excessive speed was kept up, however, only as long as it was known that an inspector was timing it. The average rate of breaking stone for the last year was 3.8 cubic yards per hour, which may be assumed as the economical rate for the 15-inch machine.

The largest sized machine (20 inches) will break 8 cubic yards per hour if fed to that capacity, but 6 cubic yards per hour is more economical.

The difference in sledging is accounted for thus:

1867. Many fence wall and cobble stones were used, which needed no sledging, but were hard to break.

1868. Refuse from quarry almost altogether used, which had to be sledged.

1869. Stone yard and quarry spauls used up.

1870. Stone-cutting and quarrying for same, done at a distance, and stone quarried near by for breaker; consequently nearly all stone used was sledged.

The carting varied in the same way for the same reasons.

The cost in time, of breaking stone, was as follows:

| | | | 1867. | 1868. | 1869. | 1870. |
|---|---|---|---|---|---|---|
| | | Total cubic yds. broken | 2,410 | 4,170 | 5,720 | 3,650 |
| | | Number of days | 109 | 152.5 | 155.5 | 96 |
| | | Average cubic yds. per day | 22.1 | 27.3 | 36.8 | 38 |
| Days per Cu. Yd. | Finishing. | Laborers sledging | 0.269 | 0.322 | 0.224 | 0.410 |
| | | " loading carts | | 0.051 | 0.042 | 0.087 |
| | | Carts hauling | 0.049 | 0.092 | 0.066 | 0.118 |
| | Breaking. | Engine and machine | 0.045 | 0.037 | 0.027 | 0.026 |
| | | Labor tending machine | 0.360 | 0.238 | 0.158 | 0.174 |

The tending was greater in 1870 than in 1869, because in the earlier year the breaking covered the working season, during a large part of which the carts hauling stone to the concrete boards took their loads direct from the breaker, while in the winter of 1869–70, all stone broken was wheeled into the pile, the wheelers being reckoned among the *tenders*. The item for engine and machine includes cost of engine driver and helpers, fuel and repairs of engine. In estimating cost of breaking, the repairs and maintenance of stone-breaker must be added. This is worth about 0.05 day laborer per cubic yard.

The stone, when broken, weighed 90.3 bounds per cubic foot, and the void spaces averaged 47.55 per cent. of the bulk.

(TO BE CONTINUED.)

## The Effect of Wind upon Sound.

Since the U. S. and foreign governments have introduced the use of the fog signals in connection with light houses on dangerous rocks and shoals, much interest has been felt in the questions—how far sound can be heard in a fog; why at times the fog seems to act on sound like an almost impenetrable *blanket:* and what effect a lofty elevation has on the distance to which the sound-waves reach. Prof. Henry has experimented largely on the subject, as has also Prof. Tyndall, and these gentlemen differ decidedly in their conclusions. Some remarks from a contemporary may therefore be of interest.

The effect of wind upon sound is a matter of common observation. Cases have been known in which, against a high wind, guns could not be heard at a distance of 550 yards, although on a quiet day they might be heard from ten to twenty miles. In light winds the effect is not so certain as in high, and sounds from a small distance seem at times to be rather intensified than diminished against very light wind. Sounds heard to windward are for the most part heard with their full distinctness. There can be no doubt that during a high wind our power of hearing is damaged, but this is the same from whatever direction the sound may come. Sounds at right angles are but little affected by wind, and when the latter is moderate sounds can be heard farther with it than when there is none. The explanation of these apparent contradictions is attempted in the *Philosophical Magazine* by Prof. Osborn Reynolds, who believes he has here discovered the refraction of sound by the atmosphere.

Sound, as is well known, generates waves in the air, which would travel along the ground, were it not that by "refraction" the ends of the wave are raised to such a height that they pass over our heads. In this case they will tend to diverge down to the ground, and throw off diverging waves, so as to reconstitute the gap thus made. The secondary waves will be heard as a continuation of the sound, more or less faint, after the primary waves are altogether above our heads. Owing to unequaled variation of velocity, those parts of the waves immediately adjacent to the ground will rise more rapidly than the part immediately above them; hence there will be a crowding of the waves a few feet from the ground, and this will lead to an intensifying of the sound at this point. Hence notwithstanding the divergence, the waves to the windward will preserve their full intensity so long as they are low enough to be heard. Elevation affects the range of sound against the wind in a much more marked manner than at right angles, Over grass or snow no sound can be heard with the head on the ground; at thirty yards it was lost with the head three feet higher; and standing erect, it was faintly heard at seventy yards. These experiments are certainly much in favor of atmospheric refraction.

## The Pneumatic Despatch in London and Paris.

(Condensed from the *Engineer*.)

The excellence in both economy and rapidity of the pneumatic over the electric telegraph, when used for sending messages over comparatively short lines, has been demonstrated in London, Paris, Brussels, Berlin, and other European cities, the system, wherever introduced, being constantly enlarged, while in no instance has it been abandoned. In London there are now twenty-four distinct tubes, of an aggregate length of nearly eighteen miles, additions being contemplated which will increase the mileage by nearly one-third. Lead is used in preference to iron, an experience of twenty-one years having shown that, with felt message-holders or carriers there is no abrasion of the metal—which, however becomes highly polished—and that the needed closeness of joints does not appreciably suffer by constant wear. In the case of two tubes, each 2610 yards long, put down some years since, iron was used experimentally, but rust almost immediately set in, and the carriers used were rapidly worn out by the undue friction. In Paris, iron is successfully used, the difference being probably due to the careful cooling to which the air is subjected before it enters the tubes (in London it is taken warm direct from the pumps), and to the use of having carriers of iron covered with leather, which by constant friction renders rust impossible.

Two and a quarter inches in diameter has been settled upon as the most serviceable size for the tubes, this being large enough to carry any reasonable traffic with sufficient speed, and yet not so large as to require a costly volume of air for driving. The difference between the Paris and London carriers, in point of weight, is quite remarkable; the former of iron and leather, weigh over a pound; the latter, of gutta percha, covered with felt, weigh but two and three-quarters ounces; yet the speed, under the same pressure, is almost equal.

The danger to which such a system as this seems peculiarly liable is the jamming of the carrier and the consequent obstruction of the tubes; but such accidents are rare. In London it has never been found necessary to open a lead tube, except in case of bad construction or of external injury caused by workmen. Now and then a carrier does get "stuck," but the application of hydraulic pressure to the tube quickly closes it. It is because of this contingency that carriers of fragile construction are used in the London service; for all exigencies of ordinary use they are quite strong enough, yet they are sufficiently frail to break under hydraulic pressure when a "jam" has taken place, and so free the obstructed tube.

The speed of the carrier is, of course, far below that of electricity, but as no time is lost in signalling at the starting point and transcribing at the receiving end, a ten-word message can be sent ten miles more quickly by the pneumatic even with two breaks in the line—than by the electric telegraph. With every added ten miles the time saved by using the tube instead of the wire is obviously increased. In point of economy, pneumatic is far ahead of electric telegraph. During the past year the total expense of the former in London was barely two-thirds of the amount which would have been required to pay the salaries alone of the clerks needed under the latter, irrespective of the cost of wires and instruments. Altogether, for local purposes, the new seems to be far preferable to the old system, its use obviating all questions as to the right or unright of companies to erect poles in the city streets, while it assures the rapid transmission of letters from point to point at a low rate of carriage.

## The Evil of Fatty Water in Boilers.

In studying the case of some boilers in a Belgian manufacturing establishment it was found that, if the feed-water contained oily or fatty matter, the iron of the boilers would be eaten away with great rapidity, and the only remedy was to put soda or potash in the water. This saponified the fat. The boilers in question were perfectly new, but leaked dangerously within three weeks, rivets being broken and plates eaten. At one time explosions took place which threatened to unseat the boilers. After an examination and trials, which lasted for several months and cost in one works $2,000 and in the other $13,000, it was discovered that there was fatty matter in the residue left by evaporation of the boiler water, the waste steam being condensed in the feed-tank, and bringing over oil from the cylinder. This formed a fatty salt with the lime of the feed-water which covered the plates with a most tenacious crust.

# ENGINEERING NEWS.

SATURDAY, APRIL 15th, 1876.

**GEO. H. FROST, - Editor and Publisher.**
*108 Washington Street, Chicago, Illinois.*

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## HYDRAULIC FORMULAE.

A recent number of the *Engineering* contains an article upon hydraulic experiments which presents a very accurate picture of the difficulties which beset an engineer when he attempts to carefully determine the flow of water through a canal of definite section and fall. We have seen some examples computed by different formulae and the results are extremely discordant. Each formula deduced from a certain number of experiments supposes that all the attending circumstances are the same in any case to which it is to be applied. Hence in our example one formula will give an approximately correct result, and in another case another. The engineer is therefore obliged to recall the original experiments from which the constants were derived, in order to select the set which correspond most nearly with the problem in hand. He then meets the difficulty that most of the experiments were carried out upon a much smaller scale than he proposes to use, and that consequently few of them are of much practical value. Upon a careful examination he will also find that one writer has copied from another, and that recent editions give only the feeble light derived from the knowledge of years ago.

The paper cited above puts the matter in an aspect which would be amusing if it were not rather disheartening to an engineer who wishes to make hydraulic calculations. He "may for a long time remain in a happy state of ignorance concerning the present state of the science, but sooner or later, when dealing with some actual or hypothetical case, the truth bursts upon him that the results given by the formulae of one cherished authority are entirely at variance with those derived from a no less venerated master, and that in short the multiplicity of his results is only limited by the number of his references."

The writer instances Neville's tables for the flow of water in canals, and these are found to be derived from Du Buat, who published his conclusions in 1785, based in some instances on experiments of 1732. "He may possibly infer that deductions which have thus held their ground for upwards of a century must necessarily be sound and trustworthy, but of course the inference would be entirely wrong." Actual construction based on Du Buat has proved him wrong. In practically the same category may be put the authority of Prony, Eytelwein, D'Aubuisson, Beardmore, Downing, Box, &c.

Of late years more carefully devised experiments, on a scale approaching the requirements of actual practice, have been carried out. D'Arcy and Bazin have experimented upon the flow of water in canals and rivers. Captain Cunningham, of the Roorkee Engineering College, India, has inaugurated a series of experiments upon aqueducts and irrigation canals. The work of Messrs. Humphreys & Abbott upon the Mississippi need not be enlarged upon to make American engineers appreciate its value. In another direction we have the careful series of experiments upon the flow of water over weirs and through short rectangular canals, by James B. Francis, C. E. published in the Lowell Hydraulic Experiments.

We were moved to these remarks by reading the recent valuable addition to our hydraulic data in the paper of Theodore G. Ellis, C. E., on hydraulic experiments with large apertures, at Holyoke, Mass., for which the American Society of Civil Engineers has awarded him the Norman medal, and which is published in the February number of the Transactions of this Society. The apertures were 2x2 feet, 2x1 feet, 2x½ feet, 2 feet diameter circular, 1 foot square, 1 foot diameter circular, and 6 inches diameter circular. The heads on centre of orifice ranged from a few inches up to in some cases about 18½ feet and the experiments numbered 74. The flow was measured over a weir, the leakage was carefully taken account of and the series of experiments were carried through with great care. All the results are tabulated and the coefficient of discharge is given for each case.

The paper makes a valuable addition to our knowledge on this subject and we hope yet to see it accessible to the profession at large.

## TESTS OF AMERICAN IRON AND STEEL.

The commission appointed to carry out the above tests has been diligently at work during the past few months. An informal statement of the progress made has been published by the American Society of Civil Engineers, and an appeal is made to its members to aid in procuring a further appropriation by bringing the matter to the attention of those members of Congress with whom they may be acquainted, Engineers are all equally concerned in having this investigation carried to a successful issue, and we have already, in No. 3 of the NEWS, for the current year, expressed our cordial endorsement. If any of our readers find it in their power to promote this object, we trust they will do so.

We append the conclusions and resolutions from the memorial of the Board of Direction of the Society.

1st. That the 400-tons testing machine ordered by the Board and now nearly three-fourths completed, has been built under extraordinarily close inspection, and is remarkably well built, both as to material and workmanship.

2d. That even without the use of this testing machine, the Board has accomplished a large amount of useful work, viz:—The establishment of a chemical laboratory and the engagement of an experienced chemist, the arrangement of a comprehensive series of comparative chemical and physical tests and the already completed analyses and preparation of specimens for test from a large number of irons and steels containing different hardening and toughening ingredients; also the preparation of a complete series of specimens of the various bronzes, a number of which has been submitted to analysis and to a part of the necessary mechanical tests—the results of which must be that all these materials can be more closely adapted to the large variety of stresses they will have to bear in use, thus avoiding the present excess of material and cheapening structures and machinery as well as increasing their safety, and also making the production of materials a matter of scientific synthesis rather than a trade secret; that the Board has collected and classified a mass of information about the useful work done elsewhere in testing metals; that it has commenced a comprehensive series of experiments on tool-steels, and arranged for the construction of some large iron and steel columns and girders for tests; that it has availed itself of the results of a series of tests of wrought iron, especially in the form of chain-cables, previously undertaken by one of its members for the Navy Department, and has commenced more comprehensively carrying out these experiments and completing their usefulness by means of chemical analysis; and that it has prepared as far as its means will allow, to undertake tests in other departments.

3d. That the character of the experiments undertaken and proposed by the Board is judicious and comprehensive, and if carried out on these plans will be of great value to engineers, constructors, producers of constructive materials, and the public at large.

4th. That the information derived from these experiments should be of the first and greatest value to the Government directly, in its own constructions of vessels, engines, boilers, cannon, armor-plates, light-houses, etc.

5th. That in order to carry out comprehensively useful results, the series of tests already undertaken, the Board will require a considerable sum of money, chiefly to increase its chemical department and to pay for material to be tested, and for the manufacture of such new shapes and compounds as current tests may prove it desirable to experiment upon.

*Theretore it is Resolved:* That the Board of Direction of the American Society of Civil Engineers respectfully petitions the honorable Senate and House of Representatives in Congress assembled, to grant to the United States Board appointed to test iron, steel and other metals, the sum of fifty thousand dollars, to be expended in carrying out the investigations of the Board, as explained in its various printed circulars.

In the paper on "The Construction of a Masonry Dam," the author, J. James R. Croes, C. E., was awarded the Norman Medal of the American Society of Civil Engineers, for 1874, the Board of Censors to award the prize being J. W. Adams, President of the Society; F. A. P. Barnard, President of Columbia College and Brevet Major General J. G. Barnard, U. S. A.

## SPECIAL NOTICE.

Copies of volume One of this journal are constantly in demand, and any parties who have the complete volume and wish to sell or exchange for volumes 2 or 3, will please to communicate the fact to the publisher. Numbers 2 and 7, volume 3 are still wanted and *one month's subscription* will be given for either.

## CORRESPONDENCE.

In ENGINEERING NEWS of March 4th we find a diagram of Sec. 13 and 14, T. 3., S. R., 15 W., Van Buren Co., Michigan. The N. E. ¼ of S. E. ¼ Sec. 24 was sold for 47.25 acres and the S. E. ¼ of N. E. ¼ for 64.25 and the line between the one-fourths placed where it would be if there was no lake on the section, and there is where it should be now. The 2¼ acres on Sec. 13 is not known, and was not sold; it belongs to the Government and to get a title it must be surveyed on the principle of an island and the uncovered beds of lakes. What Mr. A. J. Pierce means by measuring off the first and second 40 acres I do not understand. We are not accountable for the contents, no surveyor can legally divide a section into 8 or 16 equal parts, and if a diagram should show that to be the case, the survey would be pronounced a frand. In a practice of over 50 years I have never seen it done. S. PETTIBONE.

Ann Arbor, March 30th.

EDITOR ENGINEERING NEWS — I send the following problem in practical City Surveying in order to ascertain the theory of such a survey in other cities:

A deed describes the north line of certain lot as "commencing at a point on the east side of 'A' street 100 feet north of 'B' street, and extending eastwardly parallel with 'B' street, and *through the center of a party wall*, of the house now standing on said lot, 100 feet to an alley, etc.;" now upon surveying the line as thus described, it was ascertained that the line of the center of the said wall, produced west to the street, is distant only 97.50 feet from "B" street, and produced east to the alley is distant 103 feet from "B" street.,

Will the call for a parallel line with "B" street hold or must the centre of the wall be regarded as the line?

Cincinnati, April 11, 1876. G, W. C.

## TORONTO CORRESPONDENCE.

DEAR NEWS—In contributing to ENGINEERING NEWS an occasional communication, your Toronto correspondent begs to say that he claims little or no originality; his chief object being to note for the information of your readers, in the course of journeys in various parts of the Province, and to glean from leading newspapers, the condition and progress of the public works, railways, surveys, manufactures, mines, &c. of this country, hoping that such information in a condensed form, though it may not be entirely new, may yet be found useful for reference, to Canadian engineers, contractors and others, while at the same time not wholly devoid of interest to the same classes in the United States. He is actuated, also, by a desire to see the NEWS, edited and published as it is by a Canadian engineer, longresident in the neighboring Republic, recognised on both sides of the lines as an international journal, having for its object the promotion of the material prosperity of both countries; thereby strengthening those friendly relations which already do, and should, exist between the kindred people.

A few days since, at Ottawa, Prof. MacCoun of Belleville, the Government botanist who traveled across the Continent through British America, in 1872, with Mr Sanford Fleming, Chief Engineer of the C. P. R., made

a very interesting statement before the Immigration and Colonization Committee of the House of Commons. He showed that the average summer temperature in the Peace River country was only two degrees below that of Halifax. Coal was found all along the east side of the Rocky Mountains 200 miles from the base of that range. Seams or beds of pure gypsum, from ten to fifteen feet thick, extend along the banks of Peace River for twenty miles. At Salt River the Hudson Bay Company's employees shovel from the ground, salt which is used by the people of the country: coal and iron ore were also to be found there. "Tar Springs" were found through a district of 100 miles. The rivers and lakes are teeming with the finest fish and covered by clouds of water fowls in the season. He estimates 250,000,000 of acres of land in our North-west Territory, east of the Rocky Mountains, nearly all of which is arable and capable of supporting untold millions of people. A railway can easily be constructed from Red River to the Rocky Mountains and, he says, there would be no greater difficulty in operating a railway through the north-west in winter than in the eastern portions of the Dominion; and that the grading from Winnipeg to a point a considerable distance into British Columbia would not be so heavy as that on the Grand Trunk. He suggests that if a belt of forest were planted along the American frontier there would be no grasshopper plague north of that.

A project for the construction of water-works in the town of Brockville, on the St. Lawrence, is on foot.

From St. John, New Brunswick, we learn that the contract for building the Grand Southern Railway from St. John to Calais has been given to Henry Blanchard and his associates of Boston; operations to commence by the middle of May next, and to be completed by July, 1878.

The Ontario Car Works, London, employing a large number of men are likely to be re-opened in a few days. And the Canadian Furniture Company, of Bowmanville, have recently re-opened their extensive factory which had for some time been closed. Manufactures generally, though still dull enough, shew marked signs of improvement. Money is now more easy with us than it has been and on the whole we have grounds for the hope that in Canada we have seen the worst of the "hard times."

In the Nova Scotia Assembly the Attorney General has introduced a bill to encourage the building of a railway from New Glasgow to the straits of Canso, a steam ferry across the Straits to the Breton side and a railway thence to a point on Bras d'Or Lake; any company undertaking same to have a subsidy of $8,000 per mile, together with the present railway from Truro to New Glasgow, which the Dominion Government have promised to hand over. If no offer is received within the three months from the passage of the act, then the Government is empowered to contract for the construction of a line to the Sraits of Canso only, and allow the same rate of subsidy,

CANADENSIS.

Toronto, April 4th, 1876.

## Chicago Chapter of the American Institute of Architects.

*Proceedings of the Regular Meeting held Thursday, April 7th, 1876, at the Tremont House Club Rooms, at 2 o'clock, P. M.*

The meeting was called to order by the President Mr. P. B. Wight, and the minutes of the last meeting were read and approved. The proposed amendments to the By Laws relative to fees of Junior Members was on motion postponed.

Mr. James R. Willett read the following paper before the Chapter, entitled

"AN UNUSUAL CHIMNEY."

In 1869 I was called upon to build a boiler house and smoke stack under somewhat peculiar circumstances, so far as the chimney was concerned, and as I have never known of just such a case I have thought it proper to narrate it.

The work was for the water works at Nashville, Tennessee, the boiler house was at the foot of a steep bluff on a narrow beach of new made ground between the bluff and the Cumberland River. The bluff was about 90 feet high (I speak from memory) above the beach and the beach just above high water mark. The bluff made an angle of about 30 degrees with the vertical. Wrought iron chimneys had been in use but as they rusted out rapidly they were expensive, besides they did not reach the top of the bluff so that when the wind blew in certain directions they would not draw.

An ordinary vertical brick smoke stack of sufficient height would of course have solved the problem but it would have been expensive by necessitating going below the river water line for the foundation if the stack was kept away from the bluff, and at all events having to blast the bluff to a considerable extent to build up scaffolding and to hoist materials under difficulty, such as all know who have built high and detached chimneys.

It occurred to me that it might be economy to utilize the bluff itself. I therefore built a brick flue laid in cement, up the face of the bluff, making two or three slight bends in it (zig-zag fashion) so as to avoid putting the pressure on one point, taking advantages of the natural face of the bluff to obtain adequate support. Water was seeping out of the bluff and it required care to prevent it from finding its way into the chimney, but by cutting a shallow channel, putting in dry stone and covering this with cement concrete, we succeeded in keeping the water out. When this flue reached the top of the bluff it entered a vertical stack 40 feet high thus getting a stack about 130 high.

The cross section of the flue was a very slightly pointed brick arch 8 inches thick, almost a semi-circle of about 6 feet diameter. The flue laid against the bluff and was supported at the bends by abutting against rocky points of the bluff. The channel cut was shallow, not more than 18 inches deep and often much less, depending on the varying face of the bluff, so that the flue stood out for the most part beyond the face of the bluff. The flue proved to be an entire success and its cost was comparatively small.

The Secretary then read communications received from the New York Chapter of the American Institute of Architects, consisting of reports of two special meetings of said Chapter, called to obtain an expression of opinion, as to the controversy between the Architects of New York State Capitol and the Advisory Board of Architects engaged by the State Authorities to revise the said Architects' plans. Also, a memorial of the New York Chapter addressed "To the Senate of the State of New York." Also, a communication from the State Capitol Architect, Thomas Fuller addressed "To the Hon. William Dorsheimer, Lieutenant Governor and Chairman of the New Capitol Commission." Also, "A Report of the Advisory Board of the Senate."

After a general discussion, on motion of Mr. Samuel Street the following resolutions were presented and adopted, Mr. Willett being excused from voting.

*Resolved:* That the several communications from the New York Chapter of the American Institute of Architects, relative to the controversy between the New York State Capitol Architects and the Advisory Board of Architects, appointed by the State Authorities of New York be accepted by this Chapter; and

*Resolved:* That this Chapter fully concur with the New York Chapter of the American Institute of Architects in their expression set forth in a certain memorial addressed "To the Senate of the State of New York," and the Secretary of this Chapter be instructed to communicate our endorsement of said memorial to the New York Chapter of the American Institute of Architects.

On motion the Chapter adjourned.

HENRY L. GAY, Secretary.

### The Worcester Water Works.

In 1854 the city of Worcester employed M. B. Inches C. E. of Boston, to make the necessary surveys and estimates for the water supply of that city. This seems to have been done in a very thorough manner by the Engineer, assisted by Phineas Ball, C. E. of Worcester and Edward Sawyer, C. E., of Manchester, N. H., and the plan recommended was to use Quinsegamond Lake, a beautiful sheet of water, noted for its depth and purity, and lying at a convenient distance from the city, and by means of a Cornish pumping engine force the water into the pipes for the supply of the people. The cost was estimated at $395,000, which includes $232,000 for the distribution.

This plan was not adopted and in 1863, Phineas Ball, C. E. made other surveys and reported so strongly in favor of obtaining water by gravitation from Lynde Brook that his plans were adopted and he was appointed to carry them out.

January 28th, 1864, the people voted in favor of the Lynde Brook Reservoir and Aqueduct Plan by a majority of 582 and after the necessary legislation on the subject, the land purchased, and funds secured, the contracts were let; that of the earth work and masonry being taken by E. B. Walker of Oxford, and for pipe by the New Jersey Patent Water and Gas Pipe Co. The Committee in their report say: "By the promptness with which these contracts were made a very large saving was made in the cost of the work. The advance in the prices of iron and cement which took place later in the season would have increased the cost of the main pipe $30,000."

Of Lynde Brook the Committee, in 1863, say: "Like all other streams in hilly and rocky country, it is liable after sudden and heavy rains, to swell rapidly, and to subside almost as soon. In some seasons during the summer months, for days and even weeks together, it is entirely dry. During the last summer, for ten days not enough water ran in the channel of the brook to be measured, and yet during the dryest month, June, it furnished a daily average of 546,428 gallons. With such a supply, and with a reservoir capable of storing 700,000,000 gallons, filled full as it will be every spring, this does not seem to be a very serious objection. The country adjacent to and supplying Lynde Brook is so hilly and rocky that the rain passes rapidly into the stream. There are few or no swamps and little level land to soak it up and retain it. The water, instead of being held in the ground and furnished by a slow and steady supply, is poured at once into the reservoir and made ready for use."

Mr. Ball's "project contemplates building a retaining reservoir on Lynde Brook, in Leicester, and a distributing reservoir at the same elevation as the present one on Chandler Hill, and the laying of so much main pipe as shall be necessary to convey the water from the storing reservoir to the distributing, and thence along the main road to the city, and connect this main with the present City Aqueduct at Thomas Street, and then supply from the present pipes all which they will be able to distribute and lay distributing pipes only so fast as the public interests and the income to be derived from the sale of water shall warrant."

The outlet of the original collecting reservoir was 143 feet above the distributing reservoir. The estimated cost was as follows:

| | |
|---|---|
| Earthwork of dam and raising road | $5800 |
| 120 feet, 16 inch waste pipe, at $2.50, | 300 |
| One 16 inch gate, | 133 |
| Gate house | 925 |
| Roll way | 275 |
| Grubbing and clearing ground in basin | 800 |
| Cost of Waite Farm to west side of reservoir | 8000 |
| Ten acres above Waite Farm at $40, | 400 |
| Amount. | $16,633 |

Total cost, including distribution, $98,536, against $242,318 for the plan proposed by Engineer Inches in 1854. The following is a description of the original dam:

"The dam is built almost entirely of earth. Its breadth at the lowest part of the filling is 135 feet; its extreme length on the top 287 feet; the greatest filling over the bed of the original brook is 27 feet; and its width on the top, when finished, is to be 25 feet. The inside slope next the reservoir has an inclination of two to one and is paved with rubble stone over its whole surface. Running lengthwise through the dam is a rubble stone spiling wall eighteen inches thick, laid in cement. The waste pipe is sixteen inches in diameter, and laid upon the original bed of the stream so as to drain the entire baisin flowed.

"Upon this pipe and also upon the inch outlet pipe have been placed iron gates to control and regulate the flow of water. These gates are placed within the main structure of the dam, and are reached by circular gate chambers made of rubble stone laid in cement. The earth with which the filling has been made is very compact, and when the entire structure shall be completed, as designed, it is believed it will form one of the most permanent earth dams to be found in this vicinity."

### Personal.

H. C. Lowrie, C. E., was unanimously re-elected City Engineer, of Denver, Colorado, by the new Common Council of that city, on Thursday evening the 6th inst. The *Denver Daily Tribune* says: "This is as it should be. The office is one of the most important in the gift of the Council, and so long as it is filled by a competent and popular officer, as has been the case during the past term, no change is called for."

## Railroad News.

There is talk of building a road from Zanesville down to the Valley of the Muskingum river to McConnellsville, a distance of 25 miles, and possibly from thence to Marietta.

It is proposed to build a narrow gauge railroad from Winthrop Junction, Mass. on the Boston, Revere Branch & Lynn road, through Everett and Chelsea to Malden, four miles.

The Ohio Short Line Railroad Company has filed articles of association for the building of a road from Millbrook, O., westward to the Indiana State line, The capital stock is fixed at $200,000.

Articles of incorporation of the Cleveland and Southeastern Mineral railway Company have been filed. The road is to extend from Cleveland to Bowerstown, 90 miles southward. Capital stock $500,000.

A narrow gauge project of some magnitude is in contemplation, being nothing less than a road from St. Louis to the sea board via Toledo. A meeting was held in Indianapolis on Thursday, April 6, and the Indiana division of the contemplated Company was organized with S. C. Wilson as President.

The Lake Superior & Mississippi railroad Co are contemplating building a short line the coming summer, connecting with their present line, at the junction of the Northern Pacific and the above road, 24 miles west of Duluth, and running directly north for a distance of five and one quarter miles, to a point on the St. Louis river above the "Knife Falls." This short road will open up an area of about 500,000 acres of the best pine lands in the State, that is now entirely unavailable, except it be reached by a similar line, the St. Louis river (below that point) being too rapid to "drive logs." It is understood that several lumber dealers of Williamsport, Pa., are interested in the building of the above line, and if it is built we may look for unusual activity in the lumber business in that locality.

## Contractors' Intelligence.

The masonry for the new iron bridge at Le Seuer, Minnesota, is completed.

The new bridge across the Mississippi at Brainerd, Minnesota, is completed.

The contract for building the new Court House at Sioux City, Iowa, has been awarded to Hedges Brothers, of that place, for $74,700.

A petition has been presented to the Board of Supervisors of Des Moines county, Iowa, for the construction of a bridge over Dry Branch in Burlington township.

The Muscatine, Iowa, Water Works have been completed, and were publicly tested last Wednesday. The works cost about $75,000, and are on the reservoir system.

The contract for the erection of the Pennsylvania State Building on the Centennial grounds has been awarded to Messrs. Peters & Burger, who are now constructing the annexe to the Art Gallery, and also the Pennsylvania Educational Hall.

The bids for sweeping and cleaning the streets and avenues in the cities of Washington and Georgetown for one year from the 6th of May next, were opened April 5, and were as follows: D. R. Smith .500 mills per square yard, and retain sweepings; L. P. Wright .449 mills; H. Murray .526 mills; A Gleason .432 mills. D. R. Smith .526 mills, and remove sweepings where directed; H. Murray .555 mills; A. Gleason 433 mills.

Earnshaw & Gobel, of this city, have received the contract for constructing the stand pipe and tower for the Chicago (West side) pumping works, and commenced making the excavations last Monday. It will be built upon a pile and concrete foundation and will be two hundred feet in height, the first fifty feet being built of stone, and the remainder of faced brick with cut stone trimmings. The entire cost will be about $22,000.

John Davis & Co., of this city, have the contract for furnishing the entire steam heating apparatus, gas fitting and plumbing of the new building, for the State Institute for Feeble Minded Children, at Lincoln, Ill., at the price of $30,000. They have recently shipped there ten car loads of material for the work. The same parties also have the contract for furnishing the steam works for the new Cook County Hospital in this city, the cost being about $8,000.

The Detroit Bridge and Iron Works have lately completed a combination bridge for the L. S. & M. railroad Co. across the St, Louis river, in Minnesota, of 150 foot span; it takes the place of a "Howe truss".

The Eureka Bridge and Iron Co., of Chicago, have taken the contract for building an 80 feet span, iron bridge over Salt creek, in York, Du Page county, Ills., to be completed early in June. Prior to its organization the firm composing this company, constructed, in the season of 1875, eleven iron bridges in a single county in northern Iowa.

Clark & Raflen, of the Ætna Iron Works, are furnishing the cast and wrought iron work, J. W. Atkinson the galvanized iron cornices, slate work &c., and Jacob B. Hepp the general wood work for a large new business block in Elko, Nevada, belonging to E. S. Yates & Co., and J. S. Mahugh. The several contracts were let through Ben. J. Bartlett, Architect, of this city. The portions manufactured in this city have been fitted to place previous to shipment, to avoid as much as possible the high prices and unskilled labor at Elko. The work was contracted for in Chicago after an investigation of prices in San Francisco and a comparison of respective freight charges.

The bids put in for the Green River bridge on the Troy & Greenfield Railroad, recently let, were as follows:

| | |
|---|---|
| Keystone Bridge Company, Pittsburg | $46,950 |
| Boller & Bender, New York | 49,990 |
| Kellogg Bridge Company, Buffalo | 51,100 |
| Watson Manufacturing Company, Paterson | 51,490 |
| American Bridge Company, Chicago | 52,250 |
| Delaware Bridge Company, New York | 52,915 |
| A. D. Briggs & Co., Springfield | 53,712 |
| Phœnixville Bridge Company | 62,970 |
| Metropolitan Bridge Company | 71,000 |
| Cincinnati Bridge Company | 78,731 |

The above were all for pin-connected bridges. For a riveted lattice bridge three bids were submitted as follows:

| | |
|---|---|
| Leighton Bridge Works, Rochester | $46,285 |
| Niagara Bridge Works, Buffalo | 48,543 |
| Delaware Bridge Works, continuous girder | 48,200 |

The bridge is to be a three-truss, double-track, deck bridge, with three spans of 155 feet each, and two of 50 feet each, 565 feet long in all. The floor system will consist of iron cross bearers at panel points and seven lines of iron stringers. The contract was awarded to the Keystone Bridge Company.—*Railroad Gazette.*

The following bids were submitted for a bridge lately let at Hoosac Junction, on the Troy & Boston road. The bridge is of two spans, 117 feet each, on a skew of 45 degrees. The specifications were for a load of 3,000 lbs per running foot, single track, and three forms of bridge were bid for, single track, two-truss double track and the three-truss double track. The four first bids were for a pin-connected bridge, the last three for a riveted lattice:

| | Single track. | Two-truss double-track. | Three-truss double-tr'ck |
|---|---|---|---|
| Phœnixville Bridge Works | $13,000 | $24,000 | ..... |
| Keystone Bridge Works | 12,688 | 19,764 | $17,812 |
| Boller & Bender | 9,400 | 17,900 | 15,500 |
| Kellogg Bridge Works | 8,900 | 18,428 | ..... |
| Niagara Bridge Works | 8,873 | 17,124 | 15,109 |
| Delaware Bridge Works | 7,875 | 15,487 | 14,175 |
| Leighton Bridge Works | 8,200 | 15,125 | 14,000 |

The contract was awarded to the Leighton Bridge Works for a three-truss bridge at $14,000, The very great discrepancy between the bids are noticeable, especially in the single track bids, the highest being nearly 66 per cent greater than the lowest.—*Railroad Gazette.*

## Proposals for Contracts.

### BRIDGES.

Commissioners' Office,
Cincinnati, Hamilton Co. O.

Sealed proposals will be received at this office until Saturday, April 29th 1876, at 12 o'clock M., for repairing the Superstructure of the California Bridge over the Little Miami River, on the California and New Richmond Turnpike, between Spencer and Anderson townships. Specifications can be seen at this office. Jos. B. Humphreys, *Auditor.*

The Supervisors of the town of Milton will receive proposals until Friday, April 28, at 12 o'clock M., for building a bridge in Road District No. 2, near J. E. Elias' mill, on the road from Roscoe to Mantorville. The materials, with the exception of the iron will be furnished on the ground. The mason and carpenters' work will be let separate or together. The specifications may be seen at the town clerk's office. J. Cramond, *Town Clerk.*

Proposals will be received at the County Clerk's Office, in the city of Galena, Ill., on Friday, the 28th day of April, for the building of a stone bridge near the village of Hanover. Plans and specifications can be seen at the County Clerk's Office in the city of Galena and at the post office in the village of Hanover. William Howarth, Henry Chapman *County Bridge Commissioners.* John L. Phillips, C. N. Hammond, *Commissioners for the Town of Hanover.*

Commissioners' Office,
Cincinnati, Hamilton Co. O.

Proposals will be received at this office until Saturday, April 29th, 1876, at 12 o'clock M., for masonry for a bridge across Dry Fork of Whitewater on the new county road leading from New Haven to Venice in Crosby township. Specifications con be seen at this office. Also for a Superstructure at the same place, wood or iron, 140 feet clear span and 18 feet clear roadway. Also, for taking down, removing and rebuilding Superstructure on new abutments. Payments will be made in Hamilton County Bonds bearing interest at 7 per cent. Joseph B. Humphrey, *Auditor.*

Notice is hereby given that the Commissioners of Grant County, State of Indiana, will, on Friday, the 5th day of May, 1876 let the contract for the building of a bridge across the Mississinewa River at the point known as "Sutton's Ford." Plans and specifications on file in my office. By order of Board. Jos. W. Stout, *Auditor Grant Co.* Marion, Ill.

Proposals will be received by the Board of Commissioners of Monroe County, Indiana, at the Auditor's office, at Bloomington, until 1 o'clock, Wednesday, April 26th, for the building of stone abutments for bridge, and iron fence around the court-house square. Plans and specifications can be seen at the Auditor's office. Cash payments. James F. Manley, *Auditor Monroe County.*

City Commissioners' Office,
Baltimore, March 30, 1876.

Proposals, plans and specifications will be received at this office until Thursday, 27th April, at 12 M., for furnishing the materials, for and construction of an iron trussed bridge over Jones Falls on the line of John Street. The bridge to be composed of of 4 trusses. The outside lines to be 8 feet from center of truss to the line of sidewalk; the intermediate lines to be 16 feet, 8 inches from center to center. The horizontal bracing to consist of cross struts and diagonal rods, at top and bottom cords. Length between masonry, 136 feet; depth of truss, 18 feet; width of roadway, 40 feet; width of sidewalks (each) 13 feet; whole width of bridge from out to out, 66 feet. For full particulars see Baltimore *Gazette*, April 1st. N. B.—Ordinance 43, of March 1875, provides "that it shall be inserted in the contract and to be part thereof, to be secured by the bond given, that the contractor shall have the work for said bridges done at the city of Baltimore, by mechanics and workmen who are citizens of Baltimore city, and the work to be done, and all the materials that can be furnished by Baltimore contractors." John E. Toole, *Clerk to City Commissioners.*

### BUILDINGS.

Proposals will be received by me for the building of a School House, in York Township, Tama County, Iowa, until Monday, May 1. The specifications can be seen at my office one half mile west of Redman. Amos Rogers, Irving, Iowa, *Secretary of School District.*

Proposals for the erection of a School House in the Independent District of Flint River Township, County of Des Moines, State of Iowa, will be received by the undersigned, at his office, in said school district, until the 29th day of April, at 1 o'clock P. M. John H. Sudbrack, *Secretary of the Board of Directors.*

Proposals for the erection of a School House, in Sub-District No. 10 in the District Township of Beaver, County of Butler and State of Iowa, will be received by the undersigned, at his residence, in said township, where plans and specifications may be seen until Saturday, April 22d at 1 o'clock P. M. P. Wood, *Sub-Director.*

Proposals will be received by the undersigned, Trustee of Green township, Morgan County, Ind., until the 1st day of May for the purpose of erecting a Brick School House in said township, according to specifications now in his posession. Terms of payments made known on application. W. C. Cain, Martinsville *Trustee of Green Township.*

Proposals will be received until Saturday, April 22d, at the office of the Secretary of Independent School District of Center Junction, Jones County, Iowa, for building and completing a school house in said district. Plans and specifications can be seen at the office of the Secretary, at Center Junction. J. C. Houser *Secretary*, Center Junction.

Proposals will be received until the 1st of May by the Secretary of Laurel Hill Independent School District, Greenfield township, (P. O. address Martelle,) for building and completing a school house in said district. Plans and specifications can be seen at the *Eureka* office, Anamosa, Iowa, and at Dr. Belden's store, Martelle. S. C. Kemp, *Secretary.*
Martelle, March 29, 1876.

Proposals will be received for the erection of a Court House at Center City, in the County of Chisago, Minn., in strict compliance with the plans and specifications made by and signed "A. L. Gray," adopted by the Board of County Commissioners of the said county, now on file at the County Auditor's office, until the 18th day of April. The building to be completed on or before the 10th day of October. Otto Wallmark, *County Auditor.*

Proposals for the erection of a School House in Sub-District No. 2, and one School House in Sub-District No. 6, in the township of Cedar, in the county of Mitchell, and state of Iowa, will be received by James Temple in Sub-District No. 2, and Ole O. Haugerud in Sub-District No. 6, until 1 o'clock P. M. on Saturday the 6th day of May. Plans and specifications will be seen at Jas. Temple's and Ole O. Haugerud at Osage, Iowa. By order of the *Board of Directors.*

There will be offered for sale on Saturday, the 22d day of April to the lowest responsible bidder, the contract for the erection of a school house in sub-district No. 3 (Fairview) in the district township of Squaw, Warren County, Iowa, Sale to begin at 2 oclock sharp. Plans and specifications can be seen at the office of the county superintendent and at the residence of Samuel Gregg, in district No. 3. The foundation will be sold separate. By order of the Board of Sub Directors. Sam'l. Gregg, *President.*

The State House Commissioners will receive proposals until noon of May 4th, 1876, to furnish in place, complete, the metallic cornices, caps and covering of the upper dome, including the lantern, and the ornamentation of the Mansard roof, turrets and dome. Separate bids will be received: first, for the roofing and cornice work; second, for the ornamentation. The plans and specifications of said work may be seen, and printed specifications will be furnished, on application at the office of A. H. Piquenard, Acting Architect, in the new State House. Jacob Bunn, John T. Stuart, Jas. H. Beveridge, *Commissioners.*
Springfield, Ill., April 3d 1876.

Office of the Board of Co. Commissioners,
Sweetwater Co., Green River, Wyo.
March 31st, 1876.

Sealed proposals will be received by the County Commissioners of Sweetwater Co., Wyo. Ter., at the County Clerk's office, Green River City, up to 1 o'clock, P. M., May 15th, for the furnishing of material and building of a Court House and Jail at Green River City according to the plans and specifications which can be seen at the County Clerk's office, Green River City, Wyo. Ter. Bonds will be required in double the amount for the faithful performance of the contract. Commissioners reserve the right to reject any or all bids. W. P. Noble, *Chairman.* A. Mc Intosh, *Clerk.*

Tenders are invited for the building of a Court House in the City of Peoria, for the county of Peoria. Plans and specifications are on file in the office of the County Clerk at Peoria. Proposals must be submitted at or before 2 o'clock in the afternoon of Thursday, 27th day of April, and must be enclosed within the printed specifications, in an envelope sealed and directed to Jno. A. McCoy, Chairman of the Board of Supervisors, Peoria, Illinois, and marked "Proposals for Building Peoria County Court House" with the name of the bidder on the envelope. Plans and specifications may also be seen at the office of Wilcox & Miller Architects of the building, 112 and 114 Randolph Street Chicago. The bids will be opened before the Board of Supervisors on Thursday, April 27th, at 2 o'clock P. M., to which bidders are invited. The Board of Supervisors reserve the right to reject any or all proposals. Jno. A. McCoy, Chairman Building Committee.

## MISCELLANEOUS.

Tenders will be received up to noon of Tuesday the 18th April instant, for taking up, re-building, re-laying and covering about 2,600 feet of the 48 inch wooden conduit in the Toronto harbor, according to plans and specifications to be seen at the office of the Chief Engineer of the Water Commissiou, St. Lawrence Hall, Toronto. John Boyd, *Secretary*.

Iowa State Agricultural College,
Ames, Iowa, April 6th.

Proposals for putting in steam heating apparatus in the College Building—said proposals to include all labor and material connected with the putting in of said apparatus except the engine house—will be received by the Secretary of the Board of Trustees on or prior to May 1st. All bidders are required to furnish plans and specifications to accompany each bid. E. W. Stanton, *Secretary*.

U. S. Court House & Postoffice
Office of Superintendent, Evansville, Ind.
April 4th, 1876.

Sealed proposals will be received at this office until 12 M, of the 24th day of April, for the brick work and stone work required to complete the United States Court House and Postoffice, Evansville, Ind., in accordance with the plans and specifications. Copies of drawings, specifications, and any additional information, may be had on application to this office. James H. McNeely, *Superintendent*.

Proposals will be received up to 12 o'clock M., Friday, the 21st day of April, for grading and paving the full width of the carriage way of Ottawa Street with boulder stone, together with necessary curbing, gutters, crosswalk, etc., from the northeast line of lots 17 and 18, Receiver's Addition to the southerly end of the Nicholson pavement on said Ottawa Street. Plans and specifications can be seen at the office of the City Civil Engineer. G. W. Merrill, *City Clerk*, Toledo, Ohio.

The Consumers' Gas Company of Toronto, Ont., will receive tenders until 12 o'clock noon on Friday, the 21st April, for the supply of 11,000 tons (of 2,000 lbs.) of newly mined bituminous gas coal, to be delivered in the company's coal sheds, free of all charges between June 15 and Oct. 1, 1876. The coal to be paid for at the Gas Company's weights. The kind of coal offered must be specified. Tenders to be made on a gold basis and addressed to the President of the Consumer's Gas Company, Toronto. W. H. Pearson, *Secretary*.

Receiver's Office,
Missouri, Kansas & Texas Railway,
Sedalia, Mo. April 4th, 1876.

Proposals will be received by the undersigned until April 20th 1876, for building two hundred Standard Box Cars, for the use of the Missouri, Kansas & Texas Railway. For information as to specifications, patterns, drawings, &c, apply to A. A. Gardner, General Superintendent, Sedalia, Mo. Payments will be made in cash on delivery of cars at Hannibal or St. Louis. Wm. Bond, *Receiver*.

U. S. Court House & Post Office,
Office of Superintendent, Evansville, Ind.
April 3d, 1876.

Sealed proposals will be received at this office until 12 M. of the 24th day of April, for furnishing, delivering, fitting and putting in place, the wrought and cast iron work, comprising rolled iron beams, &c., in the first (1) and second (2) floors, and the cast iron columns, &c., of first story, all as exhibited on the drawings, described in the specification, and called for in the schedule. Copies of drawings, specifications, schedule, and form of proposal, and additional information, may be had on application at this office. James H. McNeely, *Superintendent*.

The undersigned is prepared to receive offers from steamboat owners for placing a steamer with good accommodation for passengers and freight on the route between Cambeltown and Gaspe calling on the principal ports on the Baie de Chaleurs. The Intercolonial Railway is now open between Halifax and St. John, and Campbelltown and will be opened throughout from Quebec on 1st July next. The steamer will be required to provide proper accommodation for the carriage of mails. Applications will be received up to Saturday, the 22d April, and they must give a description of the steamer and state the terms upon which she will be placed on the route, and the proposed rates for passengers and freight. C. J. Brydges, General Superintendent Government Railways.

Office Wheeling Gas Works,
April 1st, 1876.

Sealed proposals for furnishing and delivering in Wheeling, Gas Pipe and Special Castings, will be received at this office up to April 19th, 1876, at 5 o'clock P. M. All bids for furnishing pipe to specify the weights and thickness, and must be bid for by the foot, the pipe to be cast vertically, and to be of uniform thickness and weight. Bids for special castings to be made by the ton. Specifications for same will be furnished at this office, and all bids must state the time of delivery of all the pipe and other castings proposed to be furnished. All material furnished to be paid for in cash upon the completion of the contract, trustees reserving the right to reject any and all bids. The pipe to be furnished is to be No. 1 cast iron gas pipe, and is to be of the size and quantities following, viz.: 5,000 feet of 8 inch cast iron gas pipe; 5,500 feet of 6 inch; 18,000 feet 4 inch; 2,000 3 inch. By order of the board of trustees. I. L. Maxwell, *Secretary* Board of Trustees.

Proposals will be received at the office of the City Clerk of Columbus, Ohio, until Saturday, April 29th, at 12 o'clock, noon, for laying an Asphalt pavement on North High Street, from Naghten Street to the north corporation line, in accordance with plans and specifications on file in the City Engineer's office, in Columbus. Said pavement will contain 50,000 yards, more or less, and shall be bid for by the square yard. Also, for furnishing and setting curb on said North High Street. Curb to be not less than five inches thick, eighteen inches deep, and three feet in length, dressed on top, face and sides, joints to be dressed eight inches deep. Curb to be either Berea, Amherst or Sunbury stone. Bidders must specify the kind of stone they propose to furnish. H. M. Neil, *Secretary*.

Proposals will be received until 12 M., on the 20th day of April First.—For ventilating the present cells in the Penitentary, at a cost not exceeding $3,500 for work, labor, material, &c., according to the plans and specifications submitted by H. P. McDonald Architect, on file with the Commissioners of the Sinking Fund. Second,—For Plans and specifications for building additional cells on the Penitentiary grounds, according to an appropriation $25,000 therefor. Plans and specifications may be examined at any time prior to the award at the Executive office, Frankfort, Ky. Address D. Howard Smith, *Secretary*.


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C. H. ATKINS, *Sec. and Treas.*

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### Public Works.

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*See Advertisement.*

**Conro, Carkin & Co.,**
4 South Clark Street, Chicago, Ill.

**O. B. Green,**
178 South Water street, Chicago.

**FitzSimons & Connell,**
100 Washington Street, Chicago, Ill.

**Wm. B. Howard,**
Room 16, Metropolitan Block, Chicago.

**J. E. Miller & Co.**
34 South Clark Street, Chicago, Ill.

**Ray & Whitney,**
West end 12th Street Bridge, Chicago, Ill.

**Steel & McMahon,**
86 LaSalle Street, Chicago, Ill.

### Gas and Water Works.

**T. B. Farrington,**
101 Washington Street, Chicago, Ill.

### Roofs, Cornices, &c.

**J. W. Atkinson,**
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**A. Knisely & Co.,**
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### Mason Work.

**Barker & Smull,**
148 Madison street, Chicago.

**T. H Bryant,**
Hyde Park, Ill.

**Busse & Sturtevant,**
126 Dearborn street, Chicago.

**D. H. Call,**
47 North Ashland avenue, Chicago.

**T. E. Courtney,**
87 Washington street, Chicago.

**Cox Brothers,**
1639 Prairie Avenue, Chicago.

**Dameier & Elder,**
Room 11, 106 5th avenue, Chicago.

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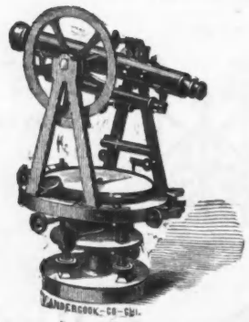

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